

Surface and Atmosphere Radiation Budget (SARB)

Clouds and the Earth's Radiant Energy System (CERES)
Science Team Meeting (Newport News, Virginia 6-8 May 2008)

T. P. Charlock (NASA LaRC)

Fred G. Rose (SSAI) *speaks in WG on NEWS (Calipso link)*

David A. Rutan (SSAI) *speaks in WG on variability of SW at ARM*

Zhonghai Jin (SSAI) *speaks in WG on snow grain retrieval,*

. **Seiji Kato** (SSAI) - modification of LaRC Fu-Liou code

Wenying Su (SSAI) - UV, PAR algorithms

Thomas E. Caldwell (SSAI) - Data Management

David Fillmore (Boulder) provides MATCH assimilation

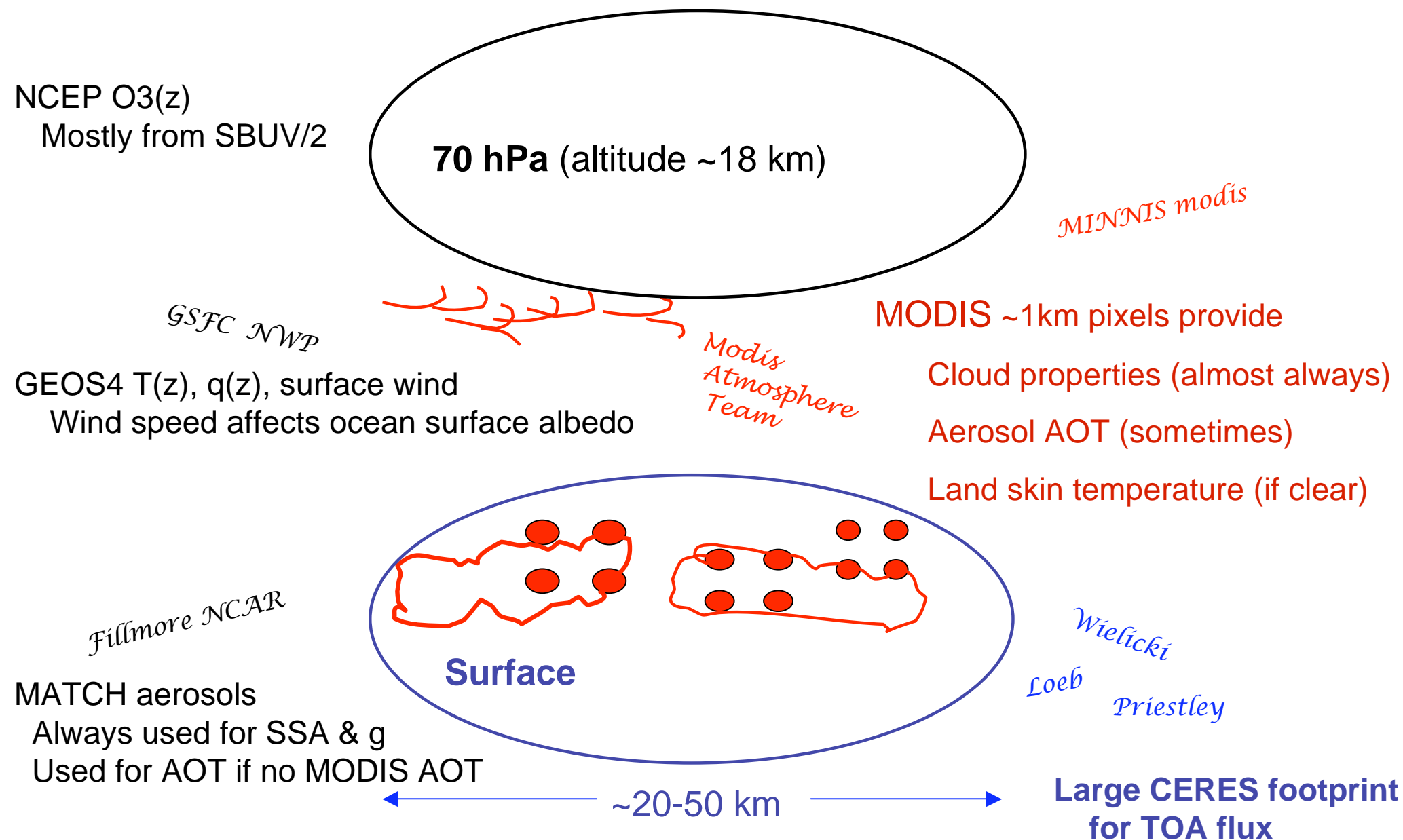
SARB/SOFA Working Group Wednesday AM

www-cave.larc.nasa.gov/cave/ or goggle “CERES CAVE”

Easy to use subsets of data, on line radiative transfer, ocean albedo tables...

Ungridded SARB vertical profile at ~2,000,000 CRS footprints/day

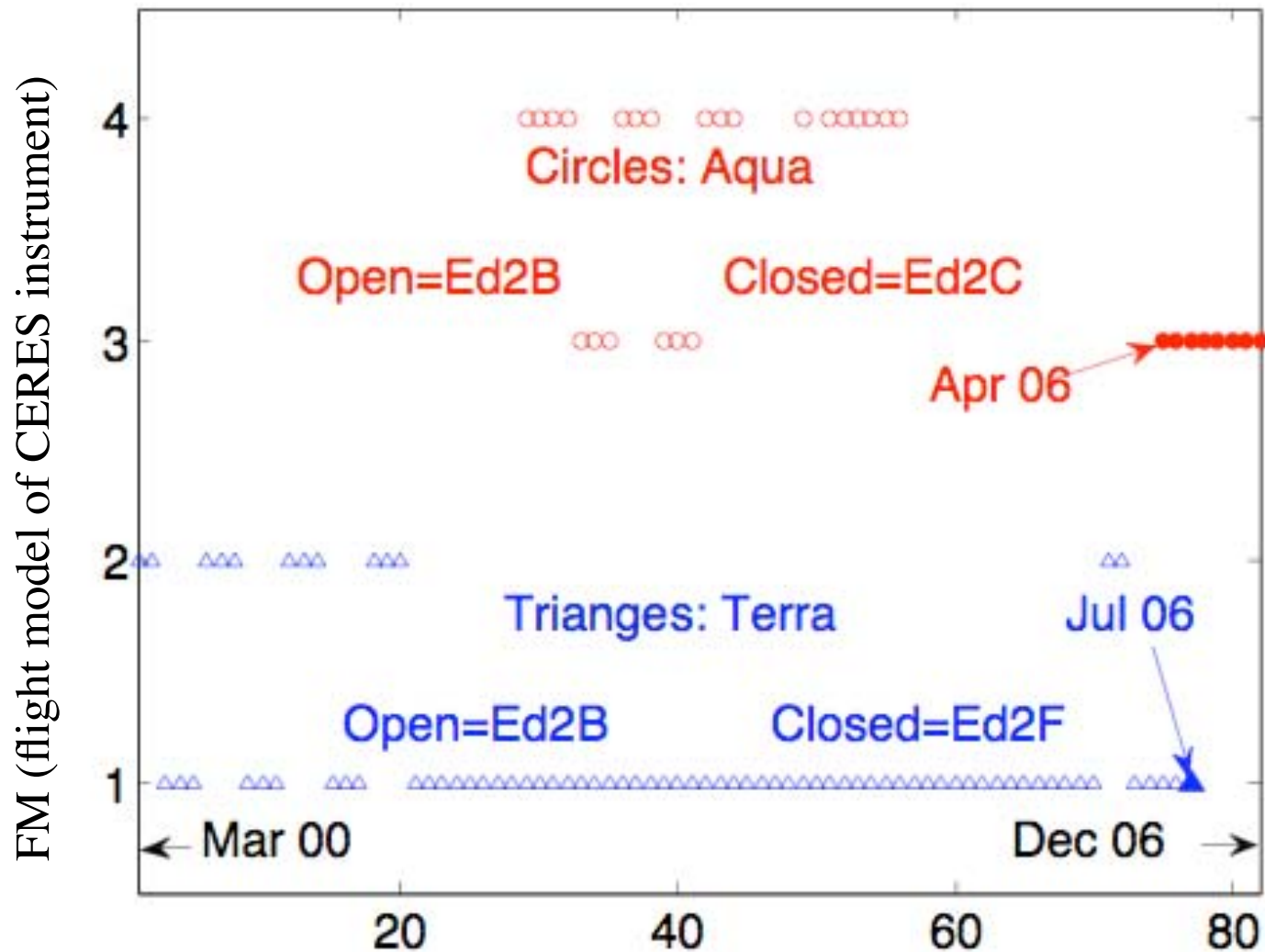
Langley Fu-Liou radiative transfer: Kato 2005 SW upgrade, retains Kratz-Rose window



CRS Edition 2 data used for field of view (FOV) based global statistics

Edition 2B - MODIS Collection 4

Editions 2C/2F - Collection 5



Data for
82 months

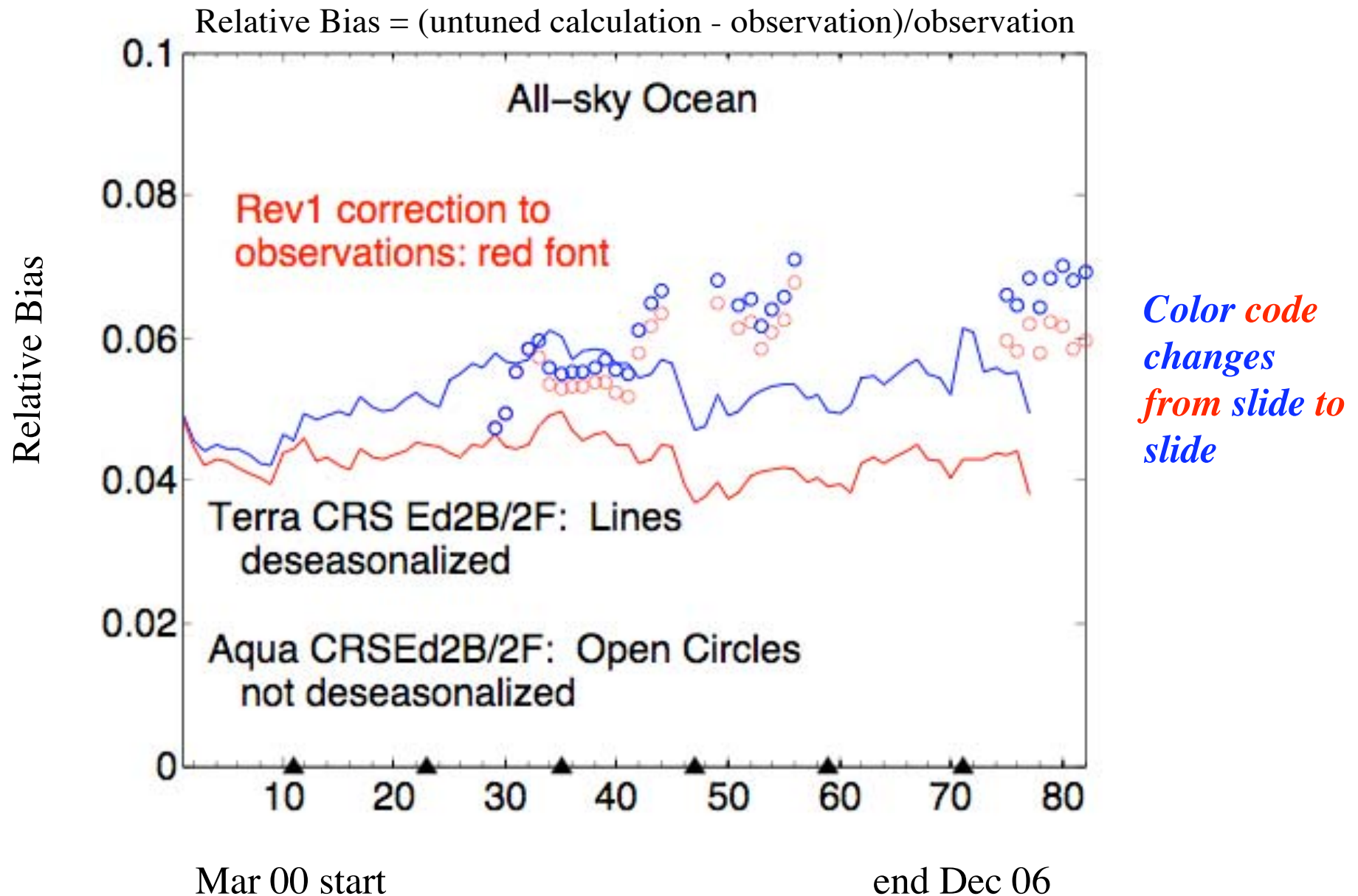
Aqua Ed2B/2C aerosols: Instantaneous MODIS retrieval or MATCH assimilation

Terra Ed2B aerosols: Instantaneous MODIS, interpolated daily MODIS, or MATCH

Terra Ed2F aerosols: Instantaneous MODIS or MATCH assimilation (as Aqua above)

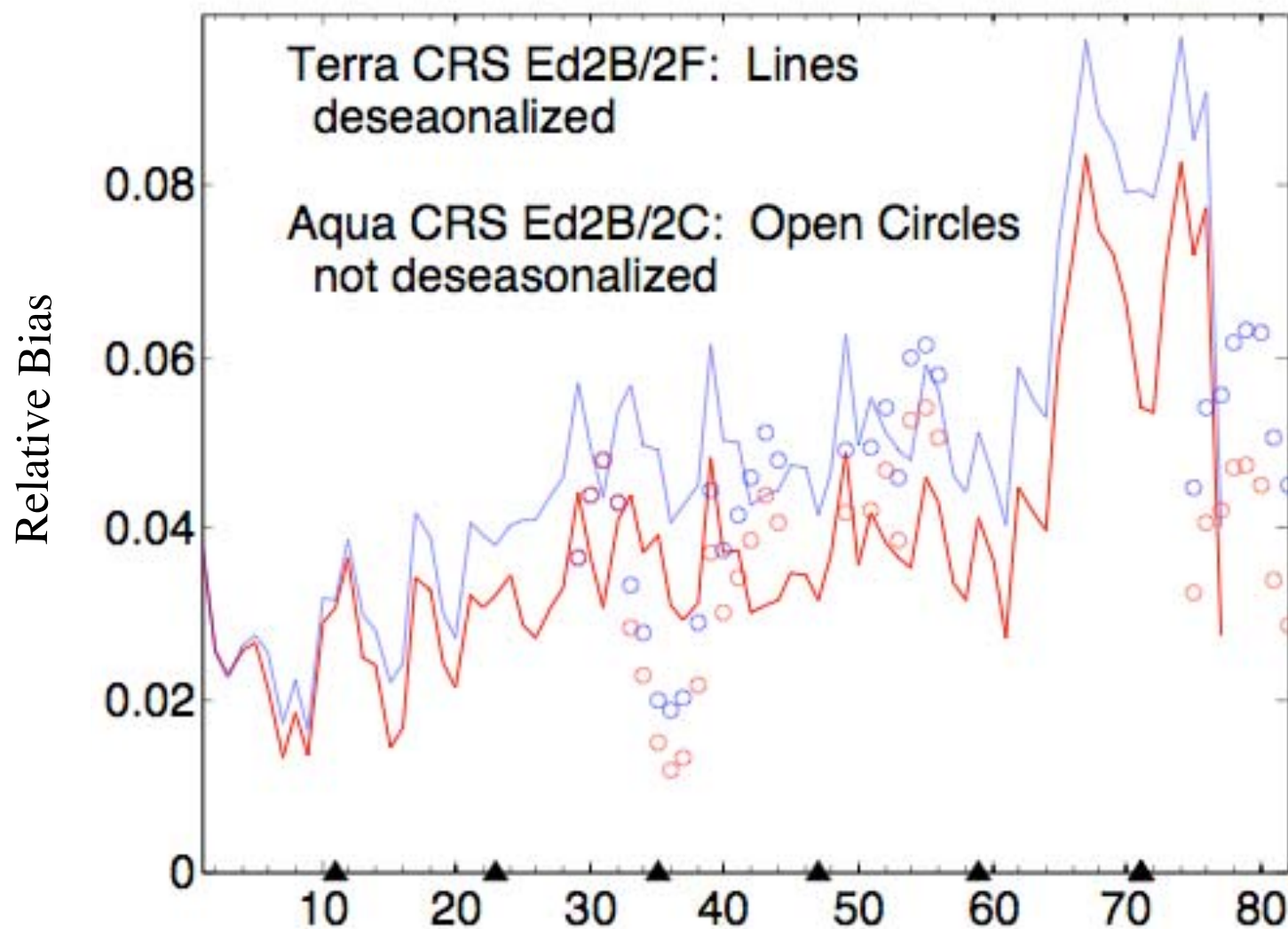
Relative Bias of Calculations for Reflected SW over Ocean

(ocean: CERES SW broadband observations do not affect input)



Relative Bias of Calculations for Reflected SW over **Clear** Ocean

(ocean: CERES SW broadband observations do not affect input)

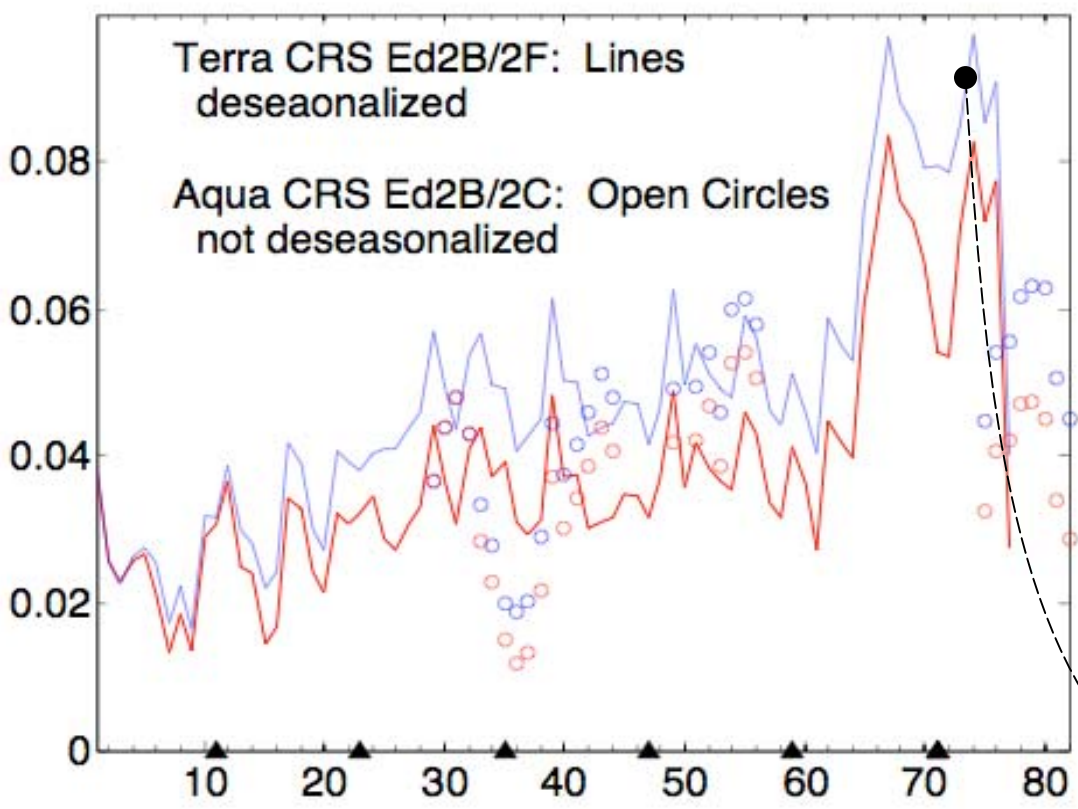


Mar 00 start

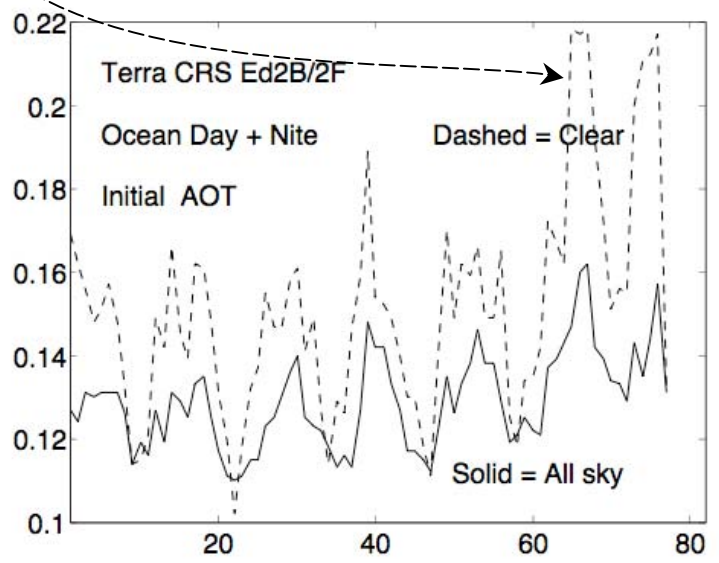
end Dec 06

Relative Bias of Calculations for Reflected SW over **Clear** Ocean

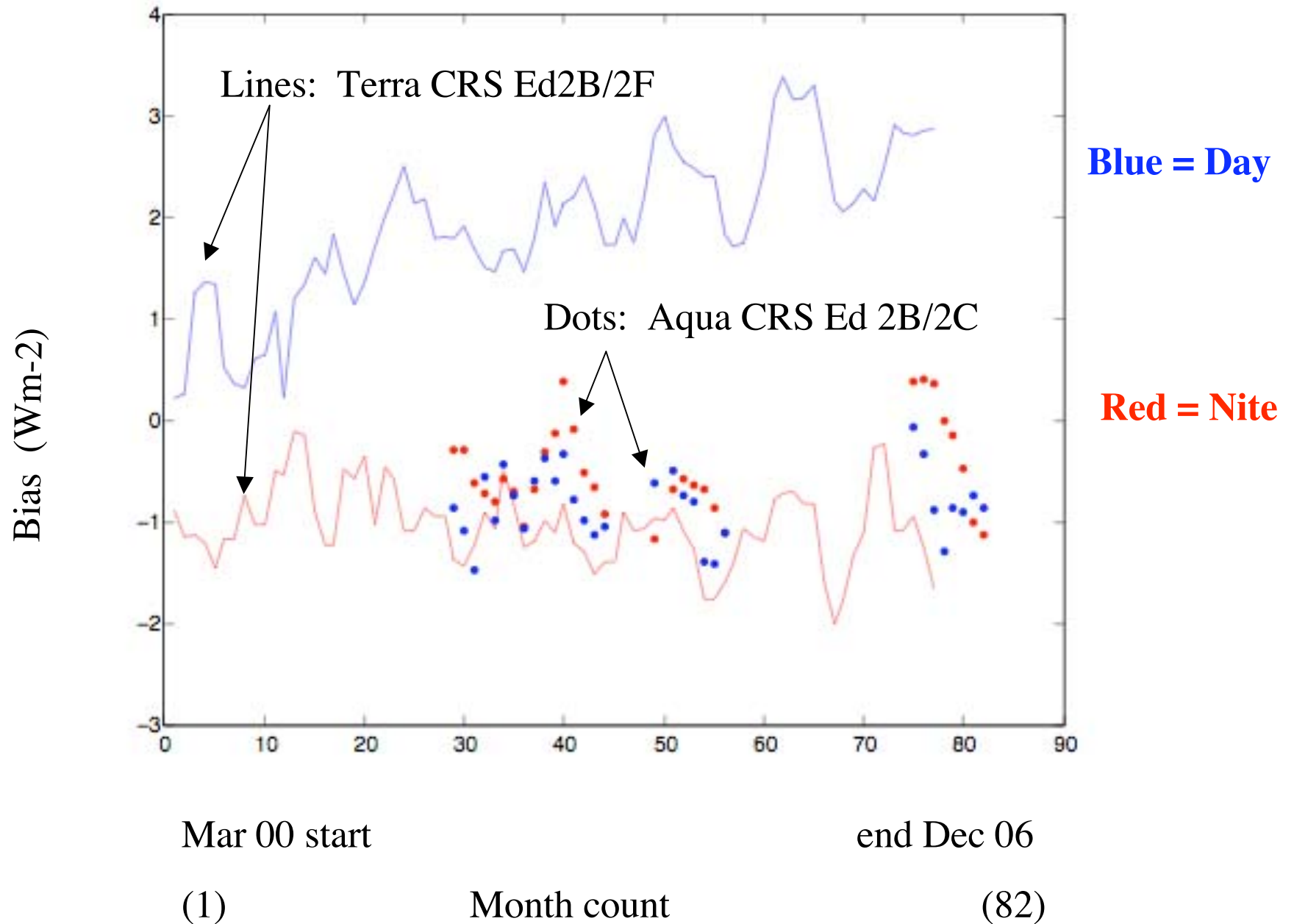
(ocean: CERES SW broadband observations do not affect input)



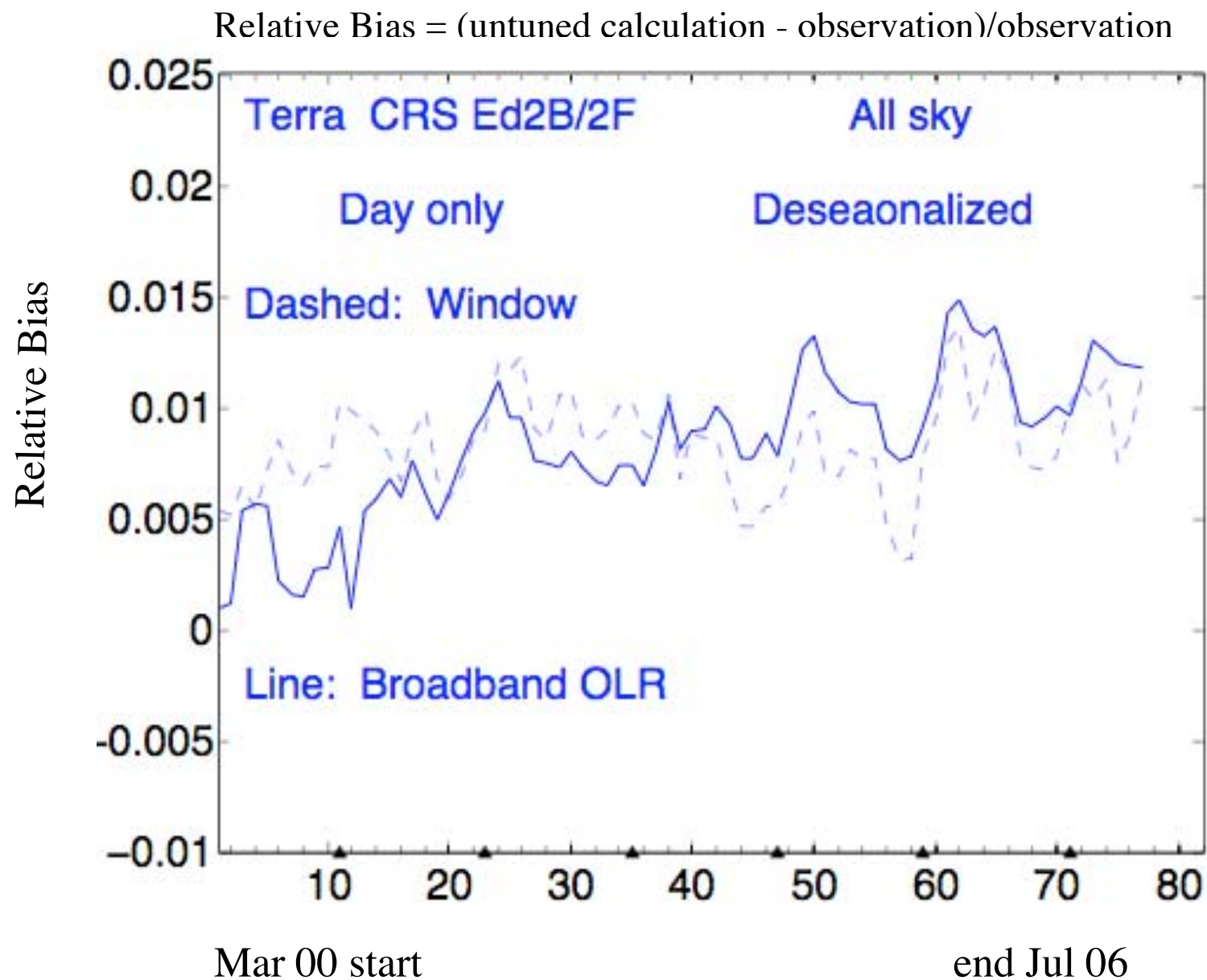
Is the input for AOT (Aerosol Optical Thickness) the culprit?



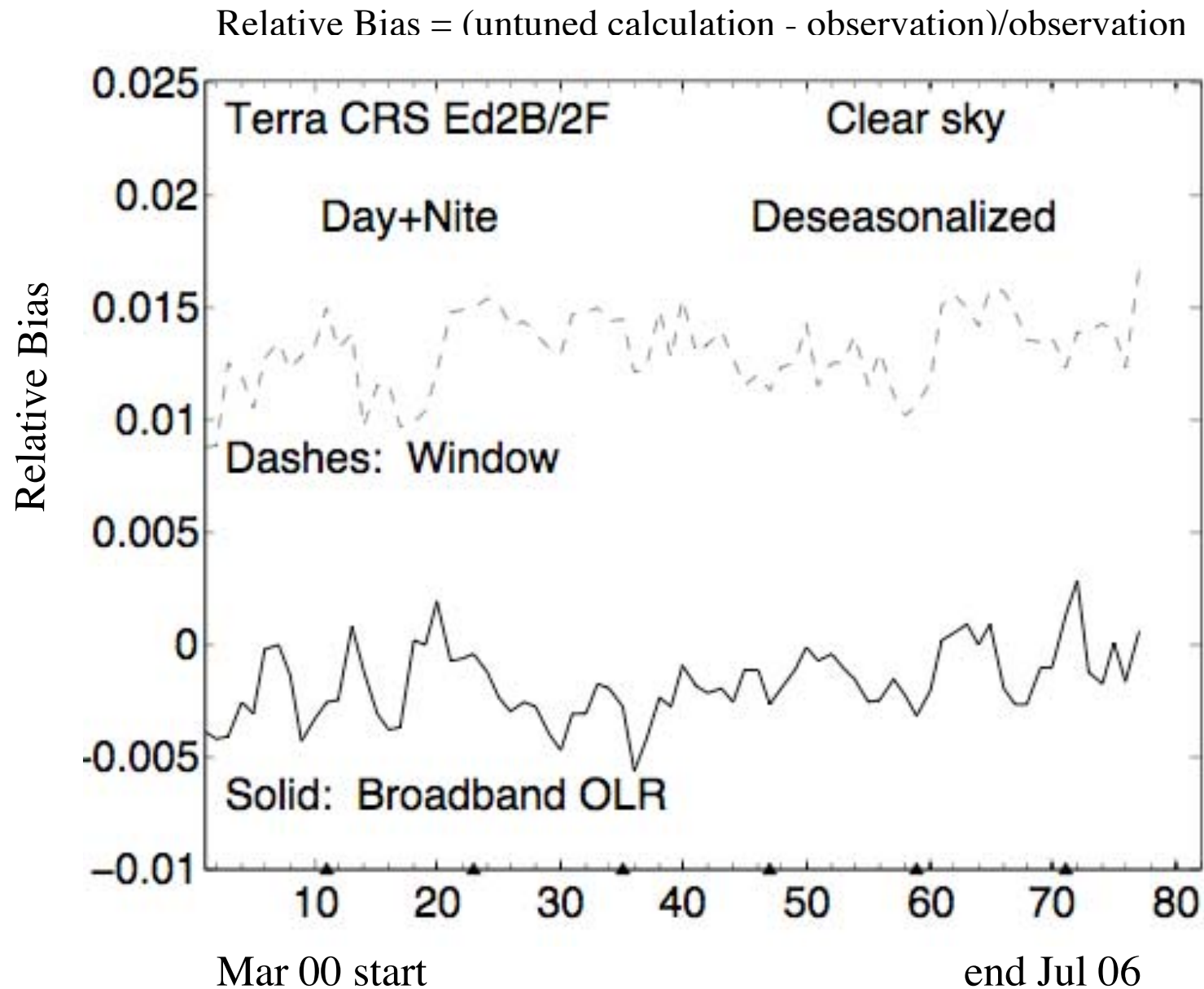
Absolute Bias of Calculated OLR for All-sky Globe (CERES FM observations do not affect input)



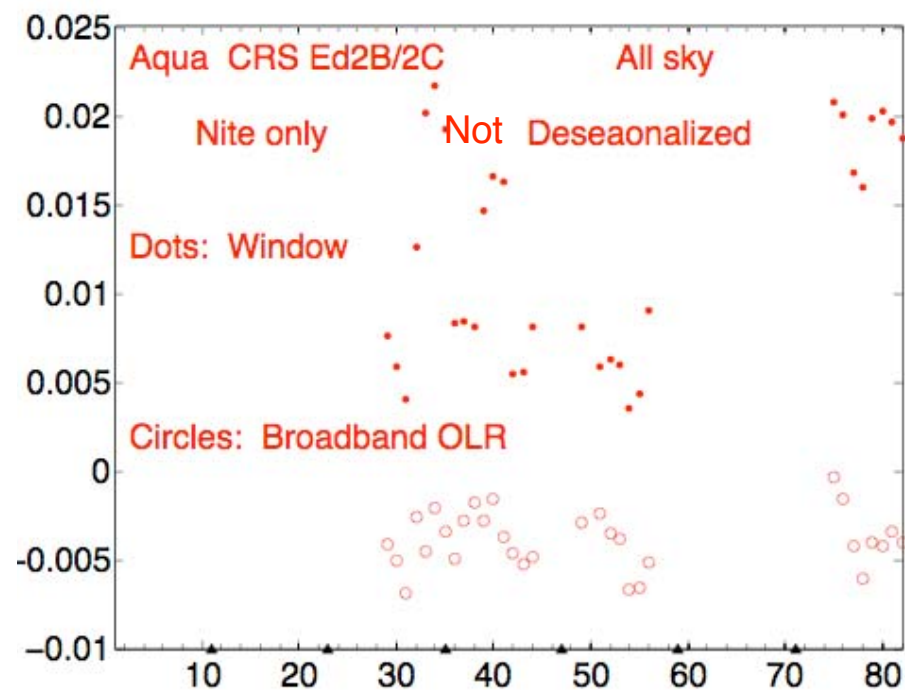
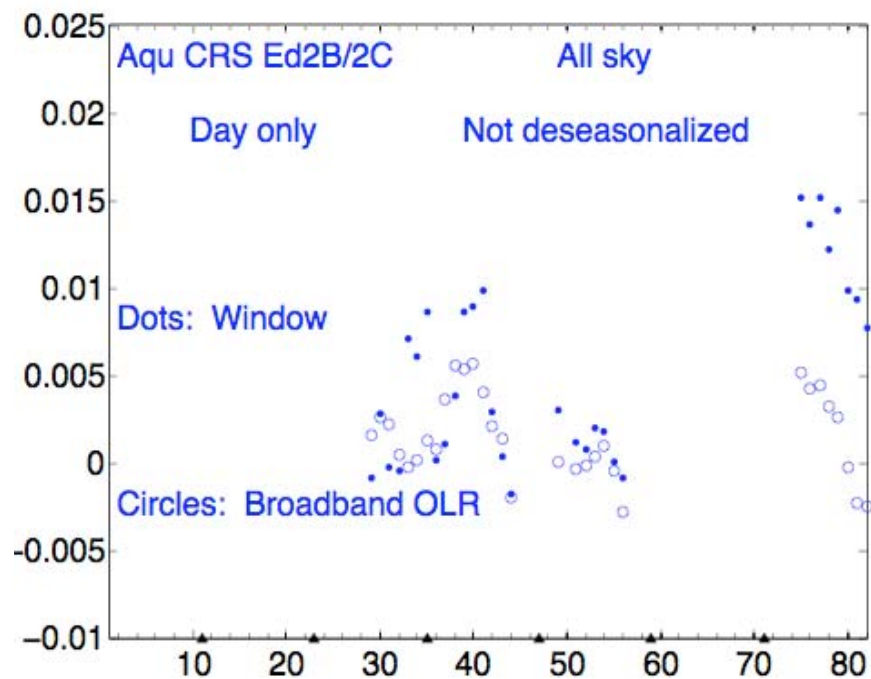
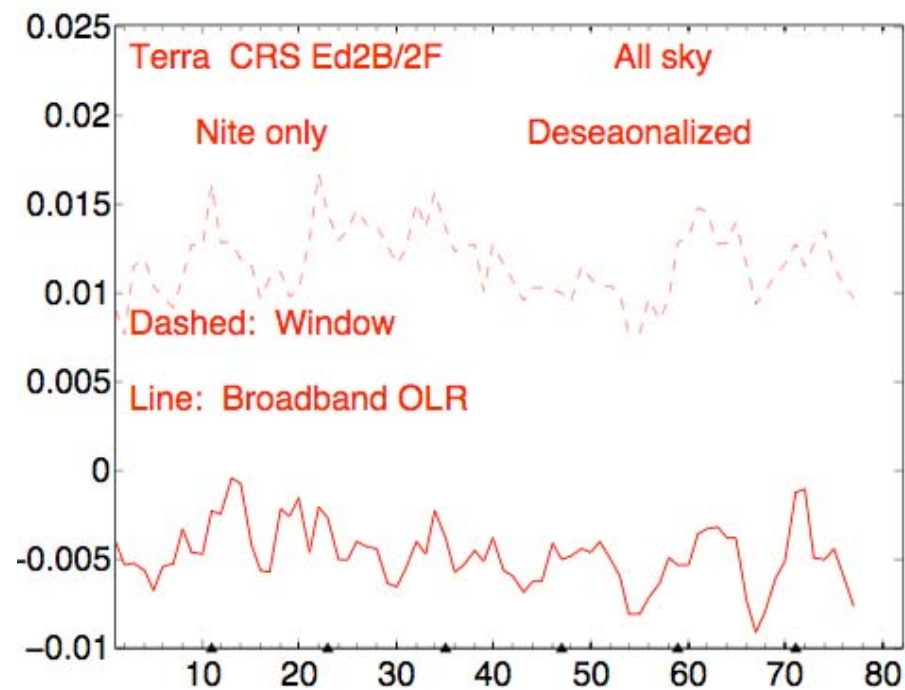
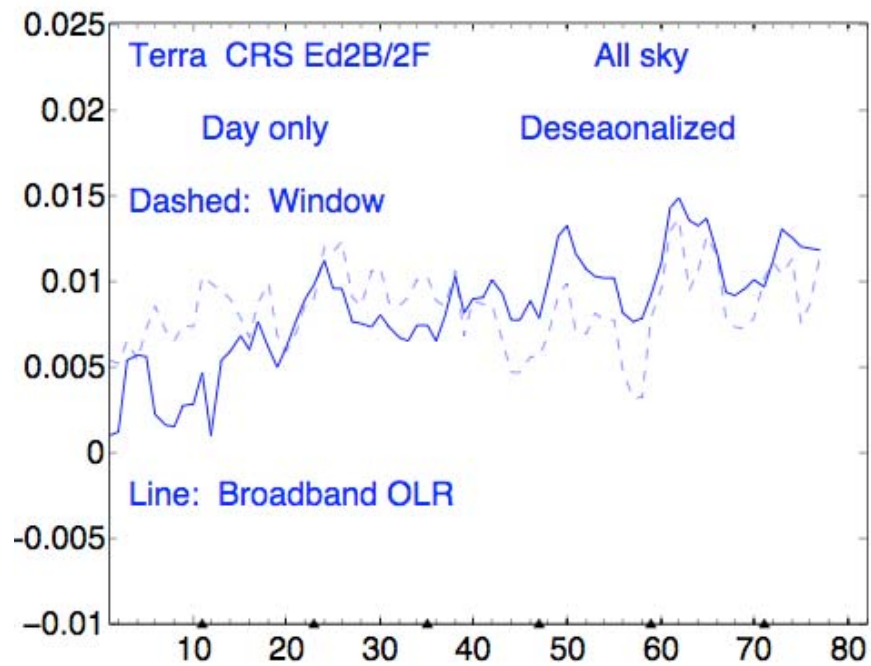
Relative Bias of Calculations for LW over All-sky Globe during Day



Relative Bias of Calculations for LW over Clear-sky Globe during Day

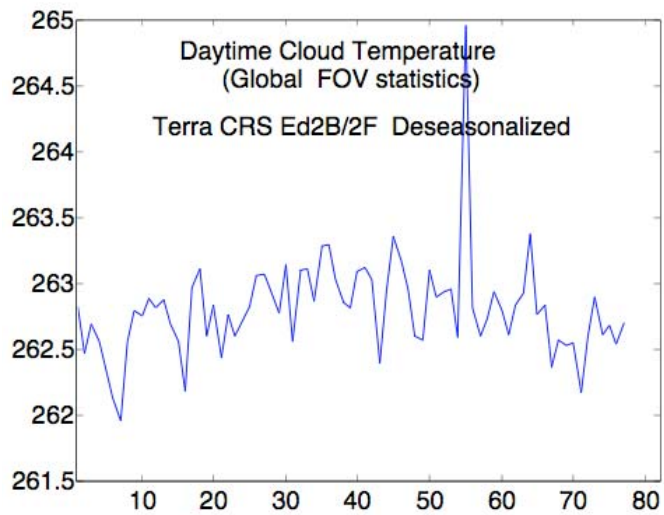


Relative Bias of Calculations for LW over Globe

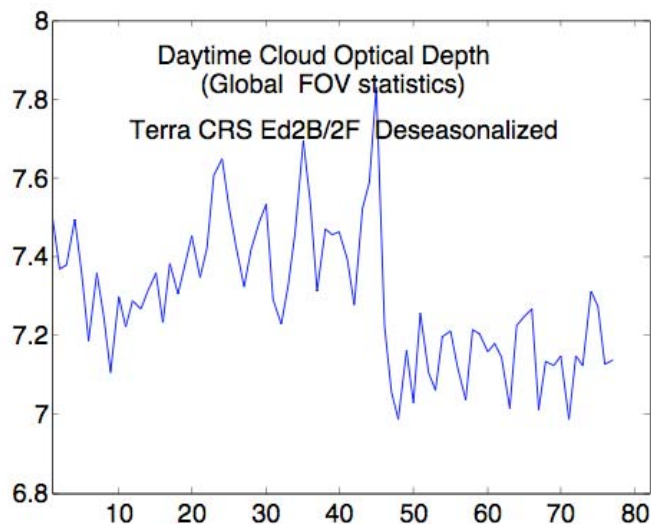


Interannual Variability of Terra Daytime Cloud and Humidity Factors

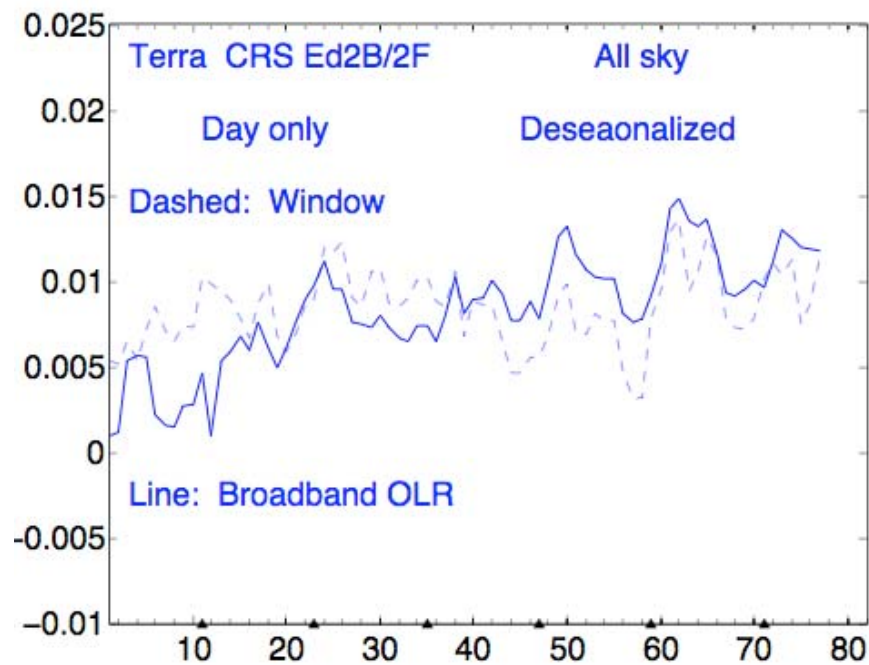
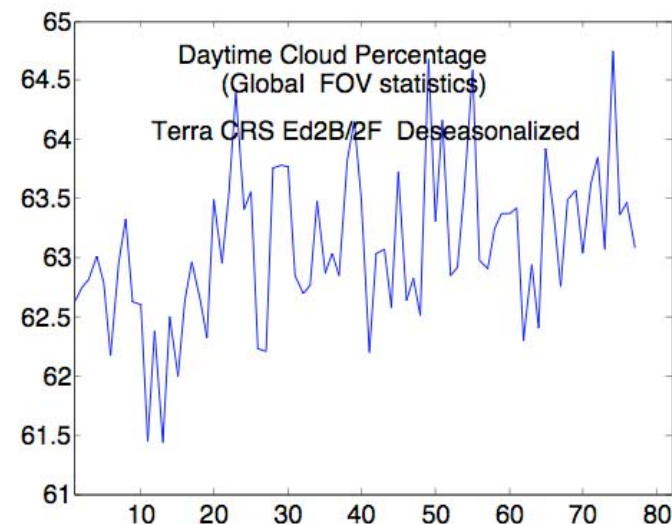
Cloud Temperature



Cloud Optical Depth

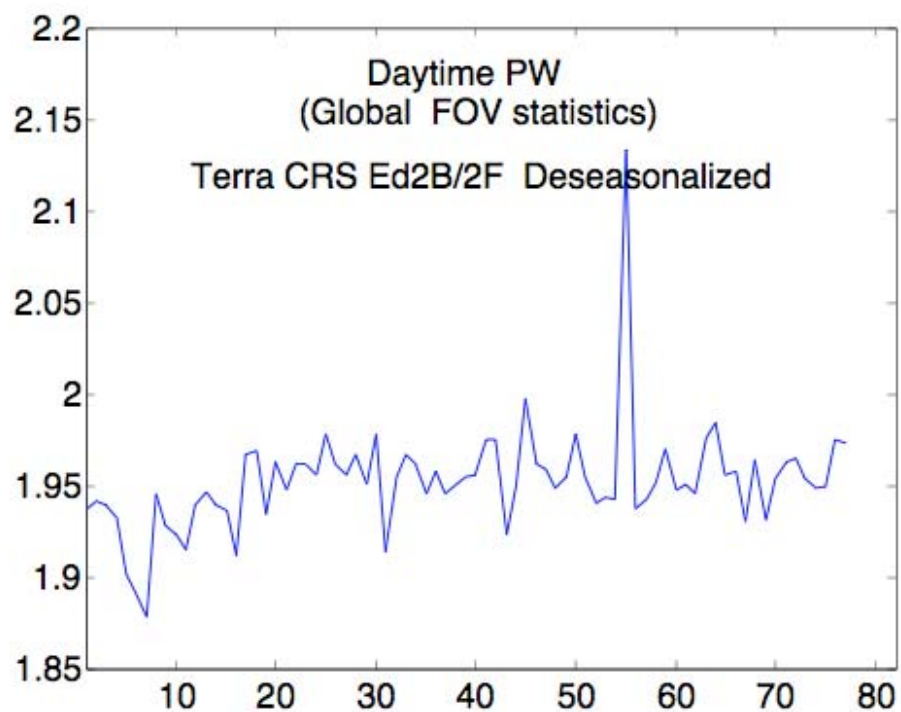


Cloud Area (%)

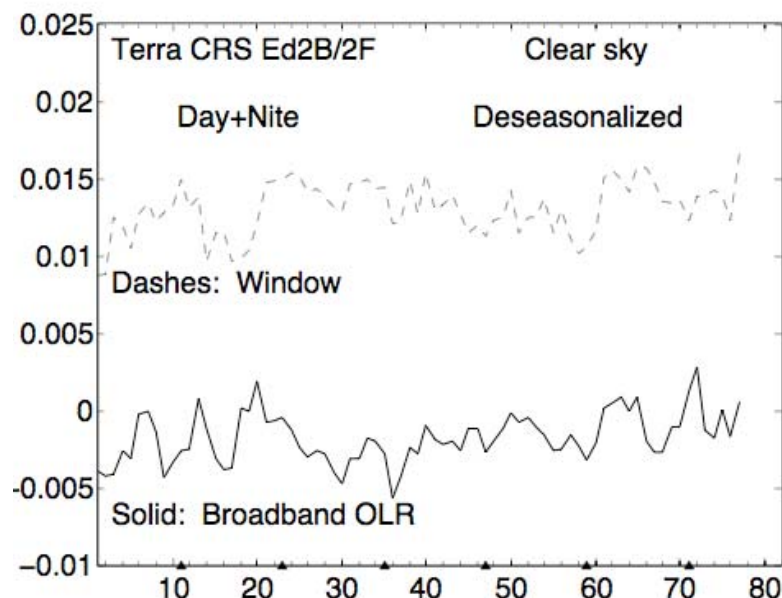
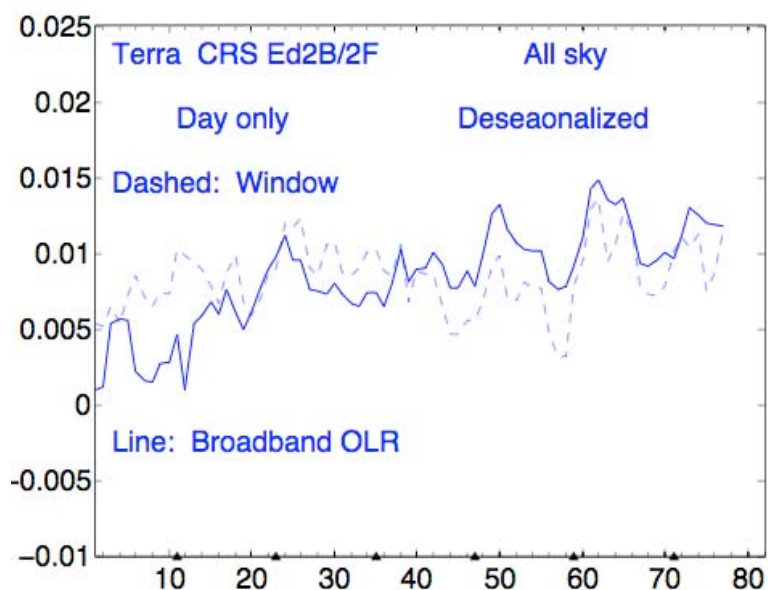
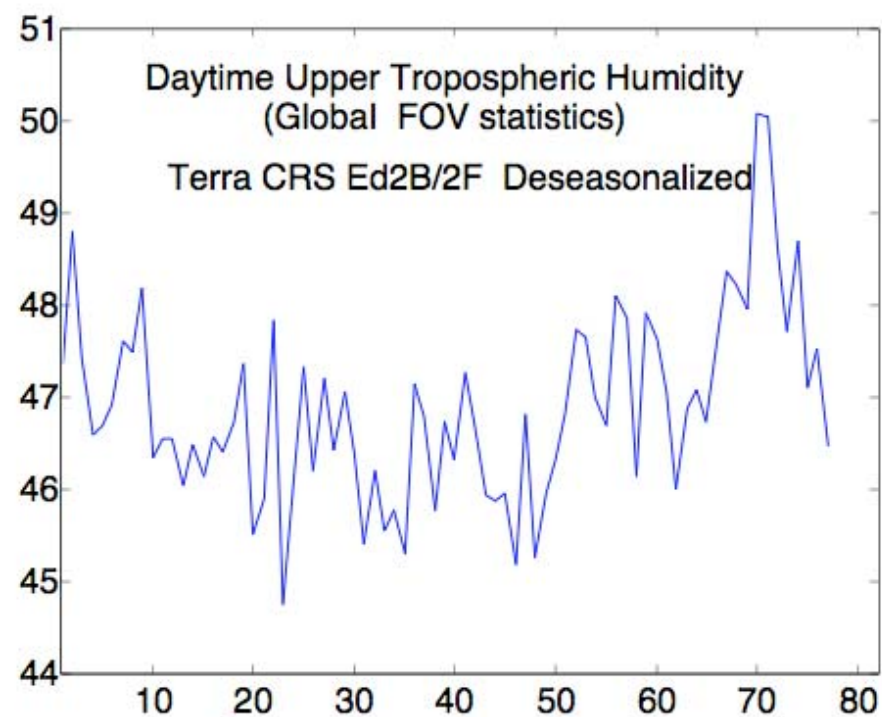


Interannual Variability of Terra Daytime Cloud and Humidity Factors

Precipitable Water



Upper Tropospheric Humidity



CRS Edition 2

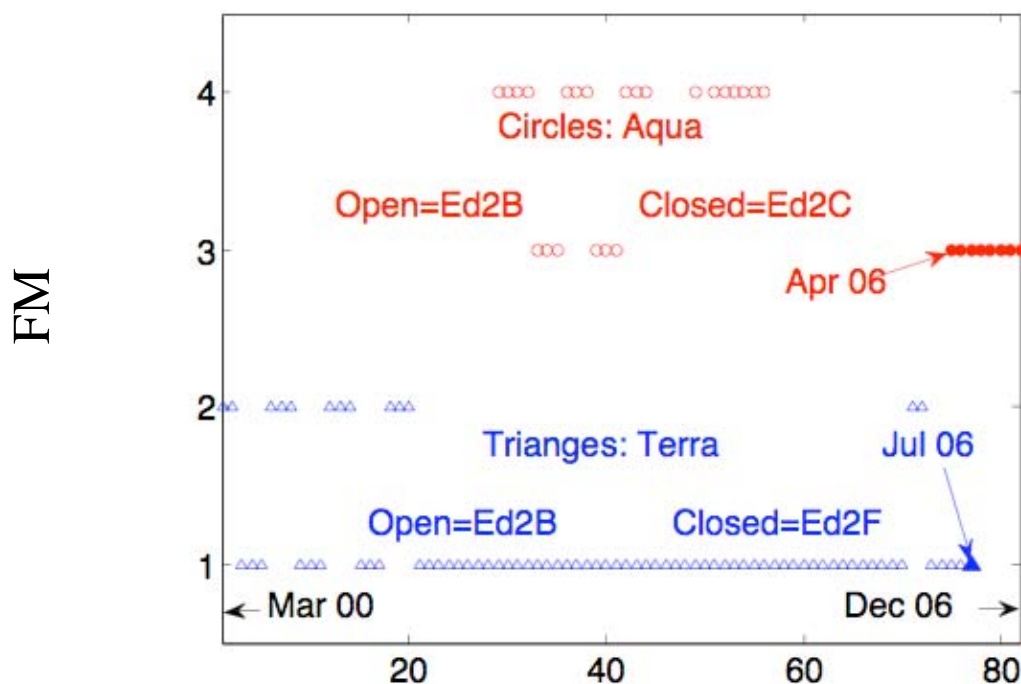
Edition 2B - MODIS Collection 4

Editions 2C/2F - Collection 5

The true meanings of these changes are given below.

4 to 5: Goddard didn't make us read a Quality Summary to get Collection 5.

2B to 2C/2F: Even better. Langley release of new Edition with no Quality Summary.



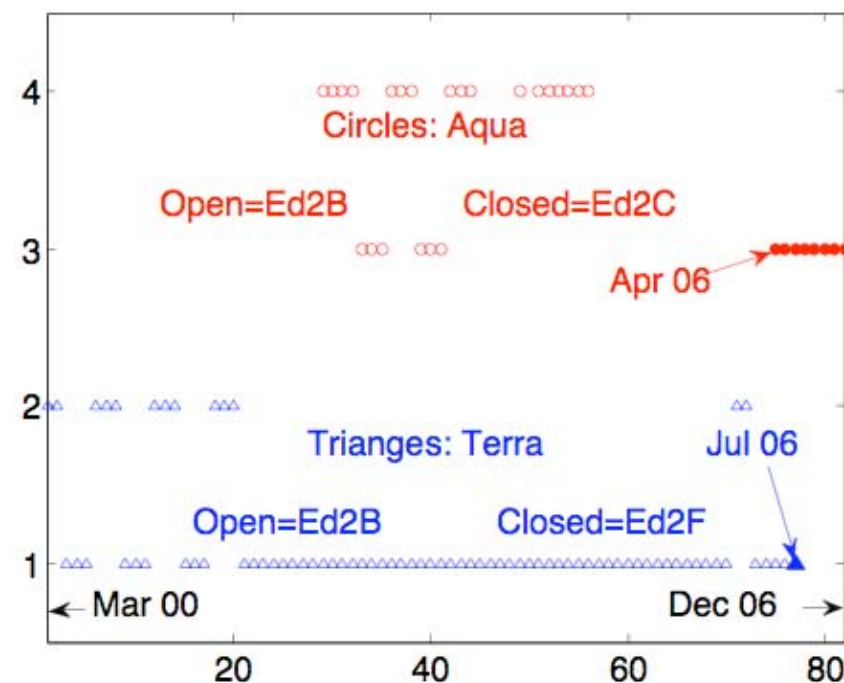
	Edition2B	ValR11 (test for Edition2F & 2C)
Terra	SSF MODIS: Collection 4 SSF MOA: GEOS4 SSF name: Edition2B Terra algorithm CRS MOA: GEOS4 MODIS gridded aerosols: yes C4 MATCH: Collection 4 SAH map: Edition2B	SSF MODIS: Collection 5 SSF MOA: GEOS4 SSF name: Edition2F Terra algorithm CRS MOA: GEOS4 MODIS gridded aerosols: no MATCH: Collection 5 SAH map: ValR11
Aqua	<i>SSF MODIS: Collection 4</i> <i>SSF MOA: GEOS4</i> <i>SSF name: Edition2B</i> <i>Aqua algorithm</i> <i>CRS MOA: GEOS4</i> <i>MODIS gridded aerosols: no</i> <i>MATCH: Collection 4</i> <i>SAH map: Edition2B</i>	<i>SSF MODIS: Collection 5</i> <i>SSF MOA: GEOS4</i> <i>SSF name: Edition2C</i> <i>Aqua algorithm</i> <i>CRS MOA: GEOS4</i> <i>MODIS gridded aerosols: no</i> <i>MATCH: Collection 5</i> <i>SAH map: ValR11</i>

Regular text = run on SGI

Italic text = run on Linux cluster

SAH map ValR11 = Edition2F SSFB (MODIS C5 GEOS4)

FM



Edition 2B and ValR11 CRS files for May 2006

	Edition2B	ValR11 (test for Edition2F & 2C)
Terra	SSF MODIS: Collection 4 SSF MOA: GEOS4 SSF name: Edition2B Terra algorithm CRS MOA: GEOS4 MODIS gridded aerosols: yes C4 MATCH: Collection 4 SAH map: Edition2B	SSF MODIS: Collection 5 SSF MOA: GEOS4 SSF name: Edition2F Terra algorithm CRS MOA: GEOS4 MODIS gridded aerosols: no MATCH: Collection 5 SAH map: ValR11
Aqua	<i>SSF MODIS: Collection 4</i> <i>SSF MOA: GEOS4</i> <i>SSF name: Edition2B</i> <i>Aqua algorithm</i> <i>CRS MOA: GEOS4</i> <i>MODIS gridded aerosols: no</i> <i>MATCH: Collection 4</i> <i>SAH map: Edition2B</i>	<i>SSF MODIS: Collection 5</i> <i>SSF MOA: GEOS4</i> <i>SSF name: Edition2C</i> <i>Aqua algorithm</i> <i>CRS MOA: GEOS4</i> <i>MODIS gridded aerosols: no</i> <i>MATCH: Collection 5</i> <i>SAH map: ValR11</i>

SSF: Cloud and aerosol retrievals for input; also broadand observations for tuning.

MOA: “Meteorology, Ozone, and Aerosol” (no longer aerosols, though) input.

MATCH: Model for Atmospheric Transport and Chemistry; an aerosol assimilation.

SAH: Monthly SARB estimate of land surface albedo for cloudy skies from clear looks.

Monthly averages of FOV-based parameters for May 2006

Terra CRS Edition 2B (Collection 4 MODIS + some gridded MODIS Daily Average AOT)

Terra CRS ValR11 (Collection 5 MODIS but no gridded MODIS Daily Average AOT)

ValR11 is the test of Edition 2F

All	Clear	Ocean	Clear Ocean	Land	Clear Land	Day	Nite	
0.03 0.02	0.00 -0.00	0.06 0.05	0.08 0.03	0.01 0.00	-0.01 -0.00	0.03 0.02		SW Relative Bias (fraction)
0.92 1.02	-0.28 0.15	0.80 0.88	0.23 0.49	1.08 1.21	-0.53 -0.01	2.80 2.93	-0.96 -0.90	OLR Bias (W/m**2)
0.55 0.63	0.80 1.12	0.50 0.56	1.27 1.45	0.61 0.71	0.58 0.96	0.48 0.58	0.62 0.67	Window Bias (W/m**2)
0.17 0.12	0.28 0.17	0.14 0.11	0.21 0.13	0.20 0.12	0.31 0.19	0.18 0.13	0.15 0.11	AOT (input)

(v2) SARB CRS 20060106 Area wgt MEAN
Global

	c4g4	c5g4o	c5g4	c5g5
Obs LW	232.897	232.905	232.915	232.913
Obs SW	117.164	117.204	117.251	117.010
Obs WN	63.527	63.532	63.538	63.535
TULWUP	234.068	234.070	233.948	233.931
TUSWUP	118.826	118.880	118.416	118.173
TUWN	64.051	64.052	64.081	63.921
UTLWUP	233.931	233.925	233.805	233.690
UTSWUP	123.255	123.305	122.109	121.920
UTWN	63.987	63.985	64.018	63.814
UTLWSFCDN	332.407	332.387	332.291	331.015
UTSWSFCDN	264.818	265.125	265.802	265.150
SZA	91.717	91.690	91.669	91.806
MNLNTAU	0.804	0.805	0.804	0.810
CLRAREA	38.204	38.256	38.274	38.498
TOAINS	450.818	451.056	451.243	449.782
Count/Gridbox	36.140	36.139	36.193	36.195
UTLWERR	1.034	1.021	0.890	0.776
UTSWERR	6.091	6.101	4.858	4.910
UTWNERR	0.460	0.454	0.479	0.279

↑ ↑
GEOS4 GEOS5

Test on 20060106 and 3 other days in
January 2006

c4g4 = Collection 4, GEOS4,
Ed2B algorithm

c5g4o = Collection 5, GEOS4,
Ed2B algorithm

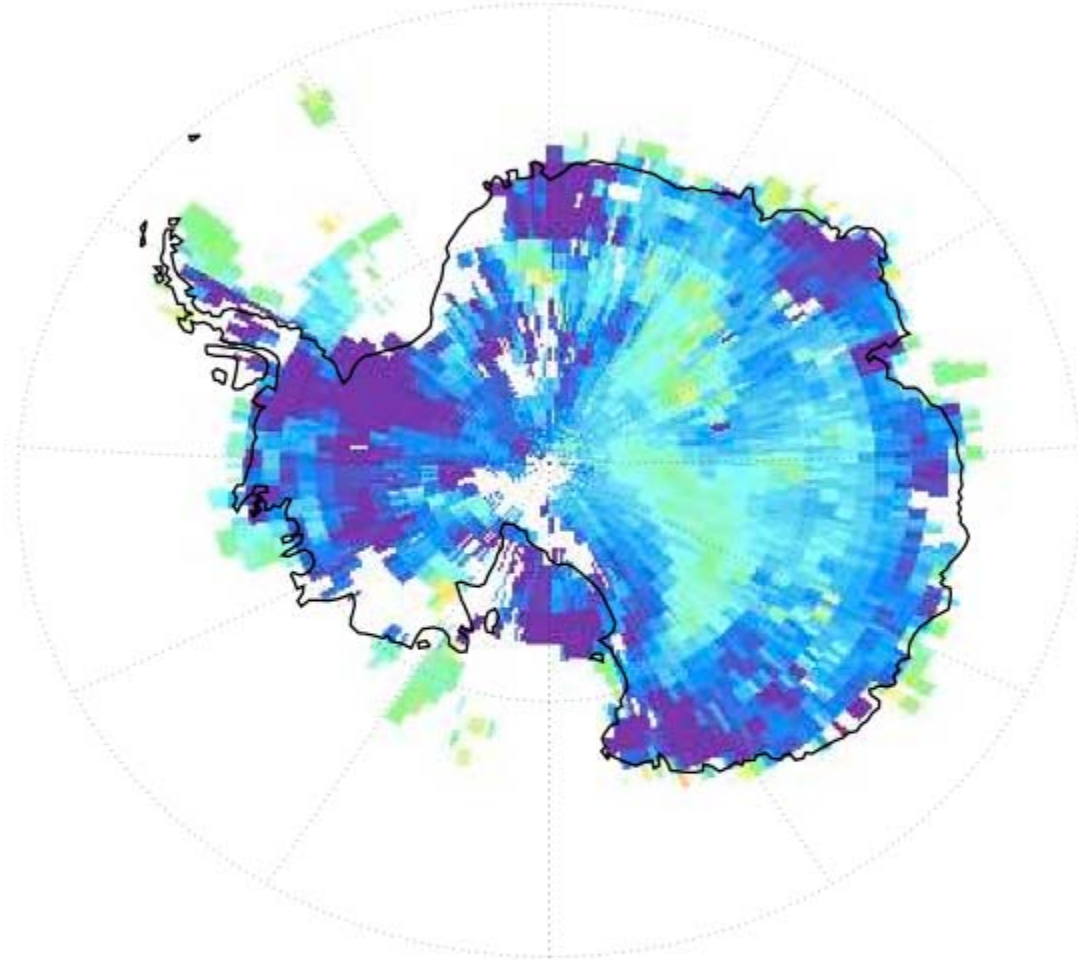
(Ed2B uses some gridded MODIS Daily
Average AOT)

c5g4 = Collection 5, GEOS4,
Ed2F algorithm

c5g5 = Collection 5, GEOS5,
Ed2F algorithm

} Bias for untuned OLR (W/m^{**2})
Bias for untuned SW (W/m^{**2})
Bias for untuned Window (W/m^{**2})

c5g5-c5g4Cry_Day_Clr MOASKIN 29
Mean= -4.492 StdDev= 3.022 N= 5840



Gridded, clear-sky comparison of
GEOS5 and GEOS4 for 4 days in
January 2006

Skin temperatures differ.
Bias (Std) with MODIS retrieval:

GEOS5: -2.8 (2.8) K

GEOS4: +1.5 (2.1) K

Which gives better input for radiative
transfer calculations?

(We use MODIS skin temperature from
Cloud WG and GEOS sounding.)

Bias(Std) for broadband OLR:

GEOS5: 0.8 (3.4) W/m**2

GEOS4: 0.4 (3.3) W/m**2



Delta Skin Temperature (K)

GEOS4/GEOS5 vs Observations at ARM Central Facility

E13	(GEOS4 vs Observations) GEOS4 Mean: Bias (RMS)			
	<u>Apr 2004</u>	<u>Jul 2004</u>	<u>Oct 2004</u>	<u>Jan 2006</u>
<u>UTRH (%)</u>	43: 12(15)	42: 14(19)	45: 8(15)	38: 14(18)
<u>Skin T (K)</u>	288.4: 0.4(3.6)	299.1: -0.2(4.1)	289.9: -0.2(3.5)	279.5: -0.7(3.7)
<u>Sfc Air T (K)</u>	286.2: -0.2(1.2)	295.4: -1.0(1.8)	288.5: -0.7(1.4)	280.7: -1.3(2.1)
<u>PW MWR (cm)</u>	1.72: -0.14(0.28)	3.38: -0.31(0.49)	2.31: -0.38(1.03)	0.84: 0.02(0.17)

Sfc Air (surface to surface -100mb) & UTRH from ARM sondes

E13	(GEOS5 vs Observations) GEOS5 Mean: Bias(RMS)			
	<u>Apr 2004</u>	<u>Jul 2004</u>	<u>Oct 2004</u>	<u>Jan 2006</u>
<u>UTRH (%)</u>	45: 14(18)	45: 17(21)	47: 10(18)	20: 16(20)
<u>Skin T (K)</u>	288.8: 0.8(3.9)	301.7: 2.5(5.0)	290.5: 0.3(3.9)	280.1: -0.2(4.0)
<u>Sfc Air T (K)</u>	286.6: 0.2(1.3)	296.9: 0.4(1.3)	289.4: 0.3(0.9)	282.3: 0.3(1.1)
<u>PW MWR (cm)</u>	1.78: -0.11(0.26)	3.47: -0.22(0.41)	2.34: -0.39(1.06)	0.85: 0.03(0.18)

GEOS4/GEOS5 vs Observations at Nauru Island

Nauru (GEOS4 vs Observations) GEOS4 Mean: Bias (RMS)				
	<u>Apr 2004</u>	<u>Jul 2004</u>	<u>Oct 2004</u>	<u>Jan 2006</u>
<u>UTRH (%)</u>	72: 25(28)	60: 27(31)	69: 32(35)	34: 14(21)
<u>Skin T (K)</u>	302.7: 1.3(2.0)	302.9: 1.2(1.7)	303.5: 1.4(2.0)	302.1: -0.6(1.4)
<u>Sfc Air T (K)</u>	296.5: -0.8(1.1)	296.0: -0.4(6.2)	296.4: -0.8(1.4)	296.7: 0.4(6.4)
<u>PW MWR (cm)</u>	5.82: -0.17(0.39)	5.06: -0.13(0.44)	5.21: -0.03(0.44)	4.68: -0.04(0.30)

Nauru (GEOS5vs Observations) GEOS5 Mean: Bias(RMS)				
	<u>Apr 2004</u>	<u>Jul 2004</u>	<u>Oct 2004</u>	<u>Jan 2006</u>
<u>UTRH (%)</u>	64: 17(20)	46: 12(19)	55: 18(22)	33: 13(19)
<u>Skin T (K)</u>	302.8: 1.3(2.0)	302.8: 1.2(1.7)	303.5: 1.4(2.0)	302.2: -0.4(1.4)
<u>Sfc Air T (K)</u>	296.2: -1.1(1.2)	295.9: -0.5(6.2)	296.5: -0.8(1.3)	296.1: -0.2(6.3)
<u>PW MWR (cm)</u>	5.89: -0.08(0.33)	5.06: -0.12(0.42)	5.222: -0.05(0.36)	4.62: -0.10(0.29)

GEOS4/GEOS5 vs Observations at Barrow, Alaska

Barrow (GEOS4 vs Observation) GEOS4 Mean: Bias(RMS)				
	<u>Apr 2004</u>	<u>Jul 2004</u>	<u>Oct 2004</u>	<u>Jan 2006</u>
<u>UTRH (%)</u>	37: 8(23)	58: 18(24)	44: 16(19)	37: 11(16)
<u>Skin T (K)</u>	260.7: 5.9(11.0)	274.2: -8.1(8.8)	273.8: 6.2(7.1)	249.5: 0.9(5.2)
<u>Sfc Air T (K)</u>	261.7: 0.0(0.9)	280.3: -2.6(6.0)	266.5: -0.3(1.8)	251.2: -0.1(2.2)
<u>PW MWR (cm)</u>	----	1.71: -0.10(0.45)	----	0.22: -0.06(0.07)

Barrow (GEOS5 vs Observations) GEOS5 Mean: Bias(RMS)				
	<u>Apr 2004</u>	<u>Jul 2004</u>	<u>Oct 2004</u>	<u>Jan 2006</u>
<u>UTRH (%)</u>	37: 8(20)	57: 17(23)	42: 14(18)	32: 6(14)
<u>Skin T (K)</u>	261.9: 7.1(11.3)	274.8: -7.5(8.1)	271.5: 4.0(4.7)	252.3: 3.7(5.6)
<u>Sfc Air T (K)</u>	261.7: 2.9(9.8)	280.5: -2.4(5.3)	267.0: 0.2(1.6)	251.8: 0.5(2.0)
<u>PW MWR (cm)</u>	----	1.78: -0.03(0.48)	----	0.25: -0.04(0.05)

Summary

Large bias for clear ocean SW in Terra Ed2B (~late '05 - early '06)
associated with input for AOT

CRS Terra Edition 2B/2F, Aqua Edition 2B/2C now extend to 2006
No very dramatic changes

Generational change of MODIS Collection 4 (in CRS Ed2B)
to Collection 5 (in CRS Ed2C/2F) should yield slightly better SW

To date, new GEOS5 ($T(z)$ and $q(z)$) appears satisfactory

